Mine Problems

- Subsidence
- Slope Instability
- Flooded Mines in Slopes
- Acid Drainage
- Waste
- Fire
- Endangered species habitat
Effect of mining on Transportation Systems

Collapse of old workings
Norwich 1988
Typical bag installation procedure. One bag being filled, the next boring being drilled, and the next bag fastened to grout pipe with rubber bands ready to install.
Typical grout bag installation details.
Design of bridges to cater for mining subsidence

Wichert truss foot bridge using concrete bearings
Design of bridges to cater for mining subsidence

Bridges subjected to 11 components of movement
Dual 3 lane bridge:
• Differential settlement of 600mm
• Change in span length of up to 300mm
• Twist of deck of 1 in 20
Radar
3D!
Side Looking Underground Radar (SLUR)
Cross-hole GPR
Seismic

- Reflection
- Refraction
- Cross-hole Velocity Logging
- Cross-hole Shear Wave Tomography
- Spectral Analysis of Surface Waves (SASW)
Reflection

<table>
<thead>
<tr>
<th>CDP_X</th>
<th>700</th>
<th>46800</th>
<th>46800</th>
<th>47000</th>
<th>47100</th>
<th>47200</th>
<th>47300</th>
<th>B</th>
<th>C</th>
<th>C'</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CDP_X</th>
<th>47600</th>
<th>47700</th>
<th>47800</th>
<th>47900</th>
<th>F'</th>
<th>48000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F'</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CDP_X</th>
<th>48200</th>
<th>48300</th>
<th>48500</th>
<th>48600</th>
<th>48700</th>
<th>48800</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cross-hole Seismic
Subsurface Characterization

New Bridge Foundation

Consolidated zone of high velocity >8,500 ft/s indicating stronger material

> 50 blows

Intermediate consolidated zone > 30 blows

Low consolidated zone < 20 blows

Limit of seismic survey

Figure 1. 3-D tomographic image showing tunnel location and selected velocity contours.
Resistivity
Falling Weight Deflectometer
FWD DATA: JAC-32-18.65

W.B. DRIVING LANE 5/28/98

Df1 DEFLECTION

0
5
10
15
20
25
30
35

STATION

-25 25 75 125 175 225 275 325 375 425 475

-994+18 -994+78 -996+0 -996+93 -997+43 -997+93
Profilometer
Vertical Time Domain Reflectometry (TDR)
Horizontal Time Domain Reflectometry (TDR)
Cavity Auto Laser Scanner
- provide 3D imagine
Synthetic Aperture Radar Interferometry
What Is Numerical Modeling?

Simulation of material behaviour under imposed conditions using computational techniques (equation solving).
Interstate Technical Group on Abandoned Underground Mines

- Alabama
- Arizona
- Canada
- FHWA
- FRA
- Illinois
- Indiana
- Iowa
- Kentucky
- Maryland
- Michigan
- Missouri
- Nevada
- New Jersey
- New York
- North Carolina
- North Dakota
- Ohio
- Ontario
- Pennsylvania
- Pennsylvania Turnpike
- Virginia
- West Virginia
Interstate Technical Group on Abandoned Underground Mines

I-70 EB Travel Lane, Ohio, 7:00 pm Saturday March 4, 1995

"Sinkholes don't have a conscience." - Bruce Beechie, North Dakota Public Service Commission

www.fhwa.dot.gov/mine
Next Workshop

- Rochester, New York
- June 13-15, 2006
- Contact:
  Priscilla Duskin
  Phone: (518)457-4731
  E-Mail: pduskin@gw.dot.state.ny.us
- More information:
  www.fhwa.dot.gov/ mine